Reinventing NASA-STD-3000, "Man-Systems Integration Standards" (MSIS)

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The "Man-Systems Integration Standards" or "MSIS" originated in 1987 under leadership from the Johnson Space Center (JSC) branch currently titled the "Habitability and Human Factors Office" (HHFO)

- **Often known by its number, "NASA Standard 3000" or "NASA-STD-3000"**
- **Developed with a Government/Industry Advisory Group of approx. 60 experts**
  - **NASA, aerospace contractors, academia, DoD, FAA, and international partners**

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MSIS is NASA's prime tool for integrating human engineering concerns into the design of space systems design with human interfaces

- **Unique among Human Engineering (HE) standards, MSIS focuses on the challenges of human spaceflight**

MSIS merged MSFC, JSC and DoD standards

- **MSFC and JSC had center-based HE standards**
  - **MSFC-STD-512A / "Man/System Requirements for Weightless Environments", 1976**
  - **JSC-07387B / "Crew Station Specifications", 1972-1982**
  - **MIL-STD-1472 / "Human Engineering Design Criteria for Military Systems, Equipment and Facilities"**

MSIS became the first Agency-wide NASA standard when issued in 1987

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MSIS topic areas:

- Anthropometry & biomechanics
- Human performance
- Natural & induced environments
- Safety factors
- Architecture
- Workstations & activity centers
- Hardware & equipment
  - Tools, Mobility Aids, Windows, Personal Equipment, Packaging, etc.
- Maintainability & facility management
  - Housekeeping, Inventory, Information Management, Stowage & Cable Management
- Extravehicular activity

Current focus is on ergonomics. Cognitive factors are underrepresented

Current focus is on hardware design, not operations, mission design, etc.

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Program support history:

	Implementation Document
• **Current and active:**	
– International Space Station Program (ISSP), including	
• Major contractor hardware	SSP 50005
• Payloads	SSP 57000
• International Partner (IP) hardware	Various
• Government Furnished Equipment (GFE)	JSC 28484
– Orbital Space Plane	OSP Document
– Space Shuttle	NSTS 07700

- **Past and inactive:**
  - Bioplex (and other ground analogs)
  - TransHab
  - Crew Rescue Vehicle (CRV)

The ISS Program has been NASA's major initiative since the inception of the MSIS and has been MSIS' major proving ground

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Prime Tenets of the MSIS Update Project:

MSIS is the NASA tool for promoting mid-TRL HE concepts to high-TRL

- Turns proven ideas and concepts into Program requirements
  - TRL = Technical Readiness Level

Lessons Learned from 10 years of use and interaction with the ISSP can make the MSIS more effective and vital

- Many more years of ISS experience to come. Update process must be more responsive

The MSIS must be updated technically and culturally to be ready for NASA's next and future programs/projects

- Changing Program management
- Changing HE technology and the Human Factors (HF) discipline
  - E.g., significant changes in human/computer interaction since MSIS' last update
- Changing data management technology and policy
  - Online presentation. Ready access (hyperlinks) to large amounts of supporting data

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MSIS Update drivers -- Policy:

Concern:

- Many MSIS "shall" statements were deemed subjective and/or unverifiable by the ISSP and removed from applicability

Response:

- Add Rationale
- Add Verification technique(s) and pass/fail criteria
  - For each "shall" statement

Also, for additional background and support:

- Add History
- Add Example(s)
- Add Supporting Research (and its TRL maturity)
- Add Risk of Not Implementing

MSIS Update drivers – Data management:

Concerns:

- With a considerable volume of new data being added to the MSIS, how will this large volume of information remain manageable?

Response:

- Migrate the MSIS to an online only document
  - Essentially complete: See HHFO's http://msis.jsc.nasa.gov/, or the NASA Technical Standards Working Group site at http://standards.nasa.gov/
- Use current display techniques to manage data availability
  - Considerable use of hyper-linking
  - Support data less likely to be stripped off by a particular program or project
- Provide data displays tailored for differences among MSIS users
  - E.g., designers may first enter MSIS by listing all applicable "shall" statements
- Provide search capabilities
- Updating can occur as new information becomes available, and need not wait for periodic full-volume revisions
  - Control of configurations will, of course, be maintained and managed

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MSIS Update drivers -- Technical:

Concerns:

- MSIS doesn't keep abreast of current technical capabilities—e.g., data displays
- Nor with new findings in the HF/HE discipline—e.g., cognitive interactions
- Nor with new areas ISSP experience indicates should be addressed—e.g., ops

Response:

- Developing tools, processes & techniques for NASA to continually update MSIS with technical data, research findings & lessons learned from flight
  - Flexible online display and database for ease of update
  - Restructuring HF resources to use MSIS as the SHFE knowledge management tool
- Where practical, defer to existing standards kept current by other resources
- HHFO will provide 1st draft of some topic updates and will engage external expertise for trial collaborations in 2004
  - Currently underfunded to engage external expertise in all MSIS topic areas
  - NASA Technical Standards Program provides formal Agency-wide review/approval
- May hyperlink to past and current SHFE (and other HF) research data

MSIS Update Project – Status & Schedule:

Display / Database:

- MSIS is currently online
- Migration to Oracle is nearly complete
  - Maximum flexibility; Add-ins auto-update hyper-text displays as new data is added
- If resources allow, launch of display design and usability testing is imminent
  - Currently in pricing with HHFO contractor

Internal HHFO Update Proposals (2004):

- Labeling and Lighting sections due in March, 2004
  - Will incorporate ISSP lessons learned
  - Engagement of and review by external expertise will then ensue
    - Internal HHFO HE teams may pursue proposed drafts of other sections as resources allow
- Identifying source data for Safety and other chapters to propose linkages rather than cut-and-paste incorporation
  - Internal HHFO database being developed by HHFO contractor and civil servant
    - Entails reconstruction/revalidation of entire MSIS bibliography & cross-reference tables
  - HSIAC delivered detailed cross-reference of DoD standards to MSIS requirements
- Strategic planning for an Anthropometry Initiative continues
  - Will include resource strategy

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NASA culture issue:

Concerns:

- Human Factors/Engineering isn't always effectively integrated into or treated as a firm requirement of NASA programs and projects
- The Department of Defense currently treats HE standards as "guidelines"

Response:

- NASA needs to study and document an effective HE integration process
  - Many ISSP examples and/or "lessons learned" already exist
  - Most ISSP HE failures/shortcomings were policy or implementation issues, not a result of inadequate technical requirements
  - Orbital Space Plane created an HE Process document
- The MSIS may be an effective place to capture such a process
  - The title of the document certainly implies this
  - May be the most important ISSP lesson learned to capture

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Changing our own culture:

JSC's Habitability and Human Factors Office will be working in the coming year to make MSIS our "core knowledge" management tool

- **Every process will include incorporation of new knowledge or lessons learned directly into the MSIS**
- **Keeping the MSIS current will be emphasized as a core HHFO value**
- **The online tools will be in place to support continuous updating**
- **Coordination and approval processes—e.g., the NASA Technical Standards Program's—must concur with the concept/approach**

Our goals are to…

- **Ensure the MSIS Update Project continues**
  - **Currently resourced through FY05 via Code U Technical Development Project and NASA Technical Standards Program funding**
  - **Additional resources—e.g., for an Anthropometry Initiative—will be pursued**
- **Never allow MSIS updates to lapse in the future**

Backup Charts

MSIS Update strategies -- Technical:

- **Direct citation:** Review current/proposed standards for replacing duplicated data with direct links to source data
  - Example: MSIS chapter 6, Safety, is largely from MIL-STD-1472, "HE Design Standard"
    - MIL-STD-1472 is kept current by the Department of Defense
    - Much of chs. 5, Environments, & 7, Health Mgmnt, is now maintained in other NASA documents
  - MSIS remains the collected NASA standard for HE—i.e., linked data remains applicable
  - Allows MSIS to focus resources on unique space human factors engineering concerns
- **True updates:** Where expertise exists, first update within HHFO then engage external expertise as resources allow
  - Examples: Currently developing Labeling and Lighting as trial updates
  - Consciously documenting update deliberation process for process lessons learned
- **New initiatives:** Current data needs significant re-structuring
  - Example: Anthropometry, Biomechanics & Strength aren't organized like other "shall" statements in the MSIS nor are they "user-friendly"
  - Launch significant revision as resources allow. Pattern after current DoD approaches
  - HHFO has internal expertise, but will engage external expertise for cross-validation
- **Outreach:** Current/Proposed chapters on specialized system HE
  - Examples: EVA (existing chapter) and Robotics (proposed)
  - Much expertise resident and knowledge documented in responsible organizations

MSIS Update Project – Strategic Outlook:

By topic areas:

	Strategy	Status	Resolution
• **Current:**			
– Anthropometry & Biomechanics	New Initiative	In planning	FY05+
– Human Performance	Direct Citation	Under review	FY04
– Environments	Direct Citation	Under review	FY04
– Safety	Direct Citation	Under review	FY04
– Architecture & Activity Centers	True Update	Partial / Planning	FY04-06
– Hardware & Equipment	True Update	In planning	FY04-06
– Maintainability & Facility Mgmnt	True Update	In planning	FY04-06
– EVA	Outreach	Under review	FY05-06
• **Discussed:**			
– Robotics	Outreach	No current activity	?
– Human/Computer Interaction	Outreach	No current activity	?
– Psychology	Outreach	No current activity	?
– Cognitive Interaction	Outreach	No current activity	?
– Operations	Outreach	No current activity	?